UNIVERSITI PUTRA MALAYSIA

BIO-EFFICACY OF COMPOST EXTRACTS FOR THE CONTROL OF CHOANEPHORA WET ROT OKRA (ABELMOSCHUS ESCULENTUS L.)

YASMEEN SIDDIQUI.

FP 2005 13

BIO-EFFICACY OF COMPOST EXTRACTS FOR THE CONTROL OF CHOANEPHORA WET ROT OF OKRA (*Abelmoschus esculentus* L.)

By

YASMEEN SIDDIQUI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of Philosophy

September 2005

DEDICATION

To my beloved parents and husband without their support and inspiration this goal could have not been achieved.

Abstract of thesis submitted to the Senate of Universiti Putra Malaysia in fulfilment of the requirements for the degree of Doctor of Philosophy

BIO-EFFICACY OF COMPOST EXTRACTS FOR THE CONTROL OF CHOANEPHORA WET ROT OF OKRA (*Abelmoschus esculentus L.*)

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September 2005

Chairman: Professor Sariah Meon, PhD

Faculty : Agriculture

Bio-efficacy of aqueous extracts prepared from rice straw (RST) and empty fruit bunch of oil palm (EFB) composts for the control of Choanephora wet rot of okra (*Abelmoschus esculentus* L.) was studied. The physiochemical and microbiological properties of both the finished composts showed that they were within the range of compost standards. RST compost extracts has higher N, P, K content of 1.14, 3.36, and 1.42 % with respect to EFB extract with 1.01. 2.51, and 1.20 %, respectively. The aqueous extracts produced therefore are suitable as foliar sprays for the improvement of growth of okra plants. Twelve days of brewing was the best extraction time based on the properties of the compost extracts obtained and their ability to inhibit the growth of *C. cucurbitarum in vitro*. The percent germination was reduced by 80 to 83 % in the presence of RST and EFB extracts. The effect was further demonstrated by using filter (0.2 µm) and heat - sterilized extracts (autoclaving at 121^{0}C for 20 minutes) for assessing their potential effect on mycelial growth, conidial germination of *C. cucurbitarum*

and production of inducible resistance related compounds in pre – treated plants. Non – sterilized extracts from both composts gave significantly reduced ($P \leq 0.05$) mycelial growth of *C. cucurbitarum* (84 and 79 % for RST and EFB extracts, respectively) and enhanced host resistance through production of inducible compounds such as total phenols, peroxidase (PO), polyphenol oxidase (PPO) and phenylalanine ammonia lyase (PAL) in okra plants. The efficacy was perceptibly reduced by filter sterilizing the RST and EFB extracts to 57 and 55 %, respectively, whereas heat sterilization nullifies their activity totally, suggesting that the activity of both extracts were biological in nature. The higher activity of filter-sterilized extracts associated with mycelial growth inhibition and percentage disease reduction as compared to heat – sterilized extracts infers that chemical factors and nutrient composition of the extracts also played a role in the activity. Humic acids (active component of humic substances in compost) extracted from RST and EFB compost extracts when tested *in vitro* reduced mycelial growth of *C. cucurbitarum* by 100 and 64.2 % at 1% concentration, respectively. The bio-efficacy was further enhanced by fortifying the extracts with *T. harzianum*, an established biocontrol agent against many pathogens. *Trichoderma* - fortified extracts (3×10^{-7} cfu ml^{-1}) from RST when tested on okra in glass house and field conditions showed significant increase in plant growth and yield. There was reduction of 91.9 % in Choanephora wet rot of okra at 12 weeks of assessment in field and was comparable to Dithane M- 45® and significantly higher to *T. harzianum* fortified EFB extracts.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

KEBERKESANAN BIOLOGI EKSTRAK KOMPOS UNTUK PENGAWALAN REPUT BASAH CHOANEPHORA BENDI (*Abelmoschus esculentus*. L)

Oleh

YASMEEN SIDDIQUI

September 2005

Pegerusi : Profesor Sariah Meon, PhD

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Keberkesanan biologi ekstrak akueus yang disediakan daripada kompos jerami padi (RST) dan tandan kelapa sawit (EFB) untuk mengawal reput basah *Choanephora* pada pokok bendi (*Abelmoschus esculentus* L.) telah dikaji. Ciri-ciri kimia-fizik dan mikrobiologi yang terdapat pada kedua-dua kompos ini menepati julat piawai kompos. Ekstrak kompos daripada RST mempunyai kandungan N,P,K yang tinggi, masing-masing pada 1.14, 3.36 dan 1.42% berbanding dengan ekstrak kompos EFB iaitu 1.01, 2.51 dan 1.20 %. Oleh itu, ekstrak akueus yang dihasilkan sesuai sebagai semburan daun untuk memperbaikelokan pertumbuhan pokok bendi. Fermentasi selama 12 hari merupakan tempoh pengekstraktan yang paling baik berdasarkan ciri-ciri ekstrak yang dihasilkan dan keupayaannya untuk merencat pertumbuhan *C. cucurbitarum* secara *in vitro*. Peratus percambahan telah menurun dari 80 kepada 83 % dengan kehadiran ekstrak RST dan EFB. Kesan seterusnya

dibuktikan melalui pengunaan ekstrak yang disterilkan dengan turasan (0.02µm) dan haba (autoklaf pada 121 ^{0}C selama 20 minit) untuk menilai potensi keberkesanannya terhadap pertumbuhan miselium, percambahan konidia *C. cucurbitarum,* dan penghasilan kompaun aruhan keresistanan pada pokok bendi yang dirawat dengan ekstrak kompos. Ekstrak kedua-dua kompos yang tidak disterilkan memberi keputusan yang signifikan ($P \leq 0.05$) merujuk kepada pengurangan pertumbuhan miselium *C. cucurbitarum* (masing-masing, 84 dan 79% untuk ekstrak RST dan EFB) dan peningkatan ketahanan perumah melalui stimulasi sebatian aruhan seperti fenol, peroksidase (PO), polifenol oksidase (PPO) dan fenilalanine ammonia liase (PAL) pada pokok bendi. Pensterilan melalui turasan mengurangkan keberkesanan ekstrak manakala pensterilan haba telah merencat keseluruhan keaktifan biologinya, mencadangkan aktiviti ekstrak mungkin dipengaruhi oleh ciri biologi semulajadi. Manakala Keberkesanan yang tinggi pada aktiviti ekstrak yang disterilkan melalui turasan berkaitan perencatan pertumbuhan miselium dan peratus pengurangan penyakit jika dibandingkan dengan ekstrak yang disterilikan dengan haba, menunjukkan kemungkinan peranan faktor kimia dan kandungan nutrien dalam aKtiviti biologi ekstrak. Asid humik (komponen aktif bahan humik dalam kompos) yang diekstrak daripada kompos RST dan EFB apabila diuji secara *in vitro* telah merencat pertumbuhan miselium *C. cucurbitarum* kepada 100 dan 64% pada 1% kepekatan. Keberkesanan biologi diperkukuhkan seterusnya melalui penambahan *T. harzianum* agen, biologi yang telah teruji keberkesanannya terhadap kebanyakan patogen kulat. Ekstrak RST yang diperkukuhkan dengan *Trichoderma*, (3×10^{-7}cfu ml^{-1}) apabila diuji pada pokok bendi di rumah kaca

dan ladang memberi peningkatan yang signifikan dalam pertumbuhan pokok dan hasil, dan mengurang/kan 91.9% reput basah Choanephora pada minggu ke-12 penilaian jika dibandingkan dengan Dithane M-45® dan peningkatan yang signifikan dari ekstrak EFB yang diperkukuhkan dangan *T. harzianum*.

ACKNOWLEDGEMENTS

My sincere gratitude goes to Professor Dr. Sariah Meon, the chairman of my supervisory committee for her dedicated efforts and scholarly guidance during the entire period of research and preparation of thesis. Her countless patience, encouragement, and generosity are commendable.

I am also grateful to Professor Dr. Mawardi Rahmani and Associate Professor Dr. Razi Ismail, the members of supervisory committee for their assistance at the various stages of my research.

I am thankful to all the staff in the pathology and chemistry laboratories, for their technical assistance.

I owe the members of my family particularly my parents, husband, my little master Hamzah and my father-in-law an incalculable debt for their love, care, sacrifices, spiritual support through their prayers and patience during the conduct of this research.

Best of all, all praises and thanks be to Allah the most beneficent and merciful, the creator of this magnificent universe and its constituents for the immeasurable guidance, good health, and direction. His name shall ever be praised and glorified.

I certify that an Examination Committee met on 8th September 2005 to conduct the final examination of Yasmeen Siddiqui on her Doctor of Philosophy thesis entitled "Bio-Efficacy of Compost Extracts for the Control of Choanephora Wet Rot of Okra (*Abelmoschus esculentus* L.)" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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This thesis submitted to the Senate of Universiti Pertanian Malaysia and has been accepted as fulfillment of the requirements for the degree of Doctor of Philosophy. The members of the Supervisory Committee are as follow:

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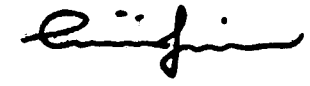

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Date: 12 JAN 2006

DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

YASMEEN SIDDIQUI

Date: 6/11/05

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LIST OF ABBREVIATIONS

$AgNo_3$	Silver Nitrate
ANOVA	Analysis of Variance
AUDPC	Area Under Disease Progress Curve
C	Carbon
Ca	Calcium
Cd	Cadmium
c.f.u	Colony Forming Units
CHB	Composted Hardwood Bark
CO_2	Carbon dioxide
Cu	Copper
CRD	Completely Randomized Design
DI	Disease Incidence
EC	Electrical Conductivity
EFB	Empty Fruit Bunch
EPA	Environmental Protection Agency
EQA	Environmental Quality Act
Fe	Iron
Fe^{3+}	Ferric Ion
g cm^{-2}	Gram per Centimeter square
HCL	Hydrochloric acid
HF	Hydrogen Flouride
K	Potassium
kDa	Kilo Dalton
Kg ha^{-1}	Kilogram per Hectare
LSD	Least Significant Difference
M	Molar
Mt	Metric Tonnes
Mt/ha	Metric tonnes per Hectare
mgL^{-1}	Milligram per liter